



Children's use of prosody and word order to indicate information status in English noun phrase conjuncts

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Abstract. Our study investigates the influence of information status on word order and prosody in children and adults. Using an elicited production task, we examine the ordering and intonation of noun phrases in phrasal conjuncts in 3-5-year-old and adult speakers of English. Findings show that English-speaking children are less likely to employ the 'old-before-new' order than adults and are also not adult-like in using prosody to mark information status. Our study suggests that even though intonation and word order are linguistic devices that are acquired early, their use to mark information status is still developing at age four.

Keywords. Information structure; prosody; word order; English; language acquisition

1. Introduction. Children acquire – with little apparent effort – the core aspects of the ambient language by the age of five years. But children must also learn how to tailor their use of language according to the informational needs of their interlocutors. For instance, children must learn to distinguish between “old” entities (mentioned in prior discourse) from “new” entities (newly introduced in the discourse). Here we focus on two means used by adult speakers to mark information status: word order and prosody. Adult speakers have a robust preference to mention old referents before new referents (Clark & Clark 1977). In Germanic languages such as English, speakers also typically accent new referents, and tend to deaccent given referents (Chafe 1974; Prince 1981). But we know little about how word order and prosody interact in the marking of information status in child language. Here we investigate word order and prosody in monolingual English-speaking children's production of phrasal conjuncts to label old and new referents. We chose conjunct noun phrases (e.g., *an apple and a spoon*), because they are easy to produce and they allow us to manipulate information status in noun phrases that do not otherwise differ in factors that also affect word order and prosody, such as topicality, semantic role, or grammatical role.

2. Background. The ordering of constituents in utterances could be motivated in terms of facilitation of comprehension for the addressee or ease of production for the speaker (Arnold, Kaiser, Kahn, & Kim 2013). In the speaker-oriented account, old referents are more activated than new referents because they have been encountered in a prior context and are therefore more available for early mention (Branigan, McLean, & Reeve 2003). In the addressee-oriented account, the 'old-before-new' order is preferred because speakers assume that comprehension is easier for the hearer when a structure is already available to which incoming information can be linked (Clark & Haviland 1977). However, prior research suggests that children have a non-adult-like ordering preference in phrasal conjuncts. Children acquiring German exhibit a 'new-before-old' prefer-

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ence when ordering noun phrases within conjuncts (e.g., *an apple and a spoon*) in contrast to the ‘old-before-new’ preference for the same construction type in adult speakers of German (Narasimhan & Dimroth 2008; Narasimhan, Duffield, & Kim 2015). Similarly, bilingual Spanish-English children have also been found to exhibit a ‘new-before-old preference’ in conjunct noun phrases in Spanish (Ceja Del Toro, Chen, & Narasimhan 2016).

With respect to prosody, studies in both English and German have observed speakers’ tendency to accent new referents and deaccent old ones among adults (e.g., Baumann & Grice 2006; Fowler & Housum 1987) as well as children acquiring German (De Ruiter 2014). However children are not always adult-like in the types of accents they use, and in the accents’ phonetic realization. Behrens and Gut (2005) found that both new and old referents were accented irrespective of information status in a German child’s multi-word utterances.

3. Study. Against this background, our study seeks to answer three main questions. Do English-speaking children prefer the ‘old-before-new’ word order like adults? Do English-speaking children use prosody to distinguish between old and new referents? How do word order and prosody interact in child language? If the ‘old-before-new’ preference found in adults is a language-independent cognitive strategy, children acquiring English will prefer this order. If, however, the ‘new-before-old’ order is the more deep-rooted preference in early childhood, children acquiring English will exhibit a ‘new-before-old’ preference, similar to their German and English-Spanish bilingual peers. On the other hand, ordering preferences in the input may play a role in children’s production: English has a relatively rigid word order, which may discourage children from using word order flexibly to mark information status. Instead, the prominent use of prosody to indicate information status in English would predict that children acquiring English may mark information status using prosody rather than word order.

3.1. METHODOLOGY. We conducted an elicited production of conjunct noun phrases, adapting the stimuli and procedure from the original study of German-learning children by Narasimhan and Dimroth (2008). Our participants were 14 English monolingual children (8 girls, 6 boys; mean age 4;5, age range 3;10 to 5;1), and 15 adults (8 females, 6 males; mean age 32, age range: 20 to 63 years). The stimuli were 23 pairs of common objects and 3 single objects (part of the fillers) presented in slides on a laptop, including 12 target pairs of English nouns for 24 inanimate objects (see Table 1), such as *ball* and *spoon* that were matched on the number of syllables and frequency of use based on child-caregiver corpora (age range 1;4 to 4;0) in the CHILDES database (MacWhinney 2000).

	Object label 1	Object label 2
1	book	chair
2	clock	plate
3	flower	crayon
4	cup	shoe
5	key	knife
6	hat	egg
7	cookie	bottle
8	tree	bus
9	ball	spoon
10	car	bed
11	apple	pencil
12	glass	shirt

Table 1: Labels for target object pairs used as stimuli

The experimental trials were interspersed with 14 filler items. All stimuli were randomized and counterbalanced into four different orders. Two lists were then created in which each object in the pair was either old or new. In the experiment, each participant was first shown an object (e.g. a spoon) on a slide. The experimenter asked: “What is on the screen”? After the participant replied, the experimenter repeated the participant’s object description, in order to make the referent sufficiently old in the context of the dialogue. The participant was then shown two objects on a slide: the old referent plus a new object (e.g. a spoon and an apple). They were asked again: “What do you see on the screen?” and their response was recorded. Figure 1 illustrates the experimental setup and the procedure. With the child participants, this procedure was slightly adapted in a child-friendly manner to keep them engaged. The experimenter introduced a stuffed animal at the beginning of the task, a Teddy Bear, who could not see the slide and wanted to know what the child had seen on the screen. Each child was first invited to make friends with Teddy by patting it. Then she or he (henceforth “she”) was asked if she would like to help Teddy learn what she had seen. All the children assented to the procedure.

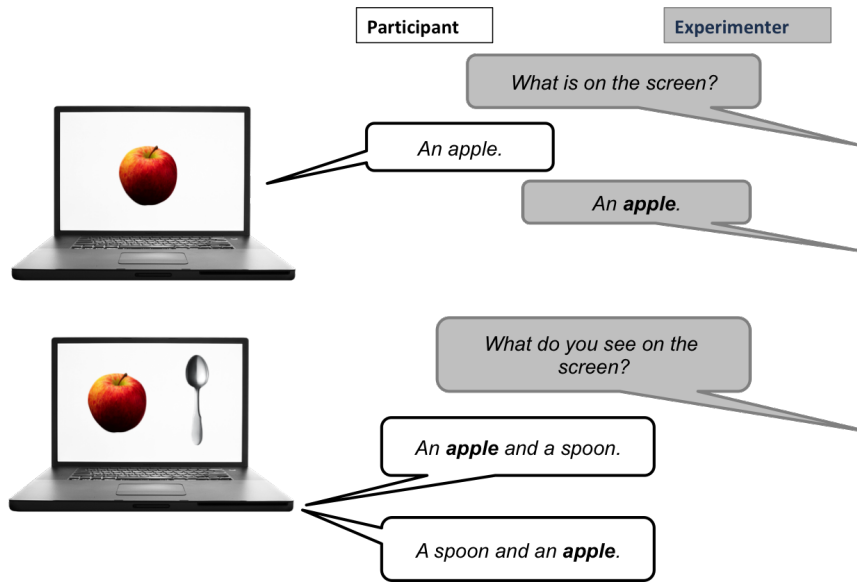


Figure 1: An example of an experimental trial

3.2 CODING, DATA, AND STATISTICAL ANALYSIS. Each response to the target pair of objects was coded for the ordering of the referents: (1) ‘new-before-old’: new referent before old; and (2) ‘old-before-new’: old referent before new. Five responses out of a total of 348 responses were excluded (four from children, one from an adult) because they did not provide the response in the target form (‘X and Y’) or because their response could not be transcribed from the sound file. Responses were also judged by a trained phonetician (the first author, blind to the experimental condition) for whether referents sounded prosodically ‘new’ or ‘old’. We then coded whether this judgment was correct or incorrect. We also analyzed a subset of the responses (children’s ‘old-before-new’ responses, see below for details) acoustically using the speech processing software Praat (Boersma & Weenink 2016). In this analysis, we examined how the speakers’ realization of the new referent (the second noun phrase) differed from their realization of the old

referent (the first noun phrase). The parameters that were investigated included F0 peak height (in Hz), F0 excursion (in Hz/sec), mean intensity (in dB), and duration of the stressed syllable (in seconds). Figure 2 shows the screenshot of a sample utterance, including transcription, segmentation, and F0 extrema.

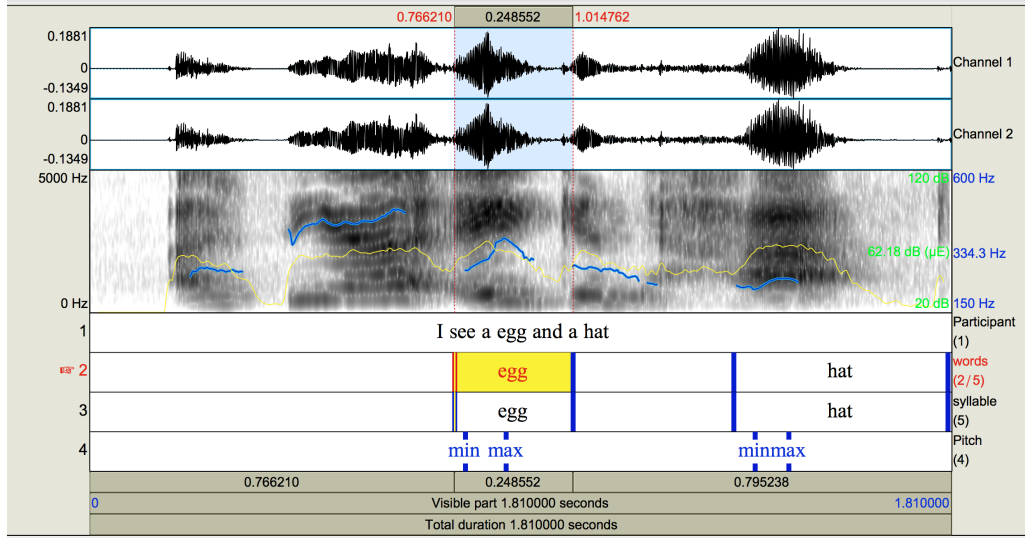


Figure 2: Screenshot of the oscillogram and spectrogram for the utterance "I see a [sic] egg and a hat", uttered by a child. The screenshot also shows the segmentation of the stressed syllables, pitch track, intensity curve, and the F0 minima and maxima on both words.

We analyzed the data using generalized linear mixed-effect models (glmer) in R (R Core Team, 2016), which included random intercepts for participants and items.

3.3 CODING. We first present the results for both age groups' word order preferences, the accuracy of the rater's prosodic judgment for each age group, and how word order and age group interacted to influence prosodic judgment. We then present the results of the acoustic analysis. Children were less likely to use the 'old-before-new' order than adults (45% vs. 84%, $\beta = -2.0455$, $p < .0001$; see Table 2). However, the children did not show a preference for the 'new-before-old' order either, as their preferences did not differ from chance ($\beta = 0.2363$, $p = .277$). The left panel of Figure 3 shows the word order preferences for both age groups.

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	1.807453073	0.272891927	6.623329226	< .00001***
Age: Child	-2.045537335	0.355891805	-5.747638201	< .00001***

Table 2: Summary of the generalized linear mixed-effects model for word order

Children were less likely to distinguish old and new referents reliably using prosodic means (60%) compared to adults (87%) ($\beta = -1.5845$, $p < .0001$; see Table 3). In fact, prosodic judgment accuracy did not differ from chance for the children ($\beta = 0.4229$, $p = .074$). The right panel of Figure 3 shows the prosodic judgments for both age groups.

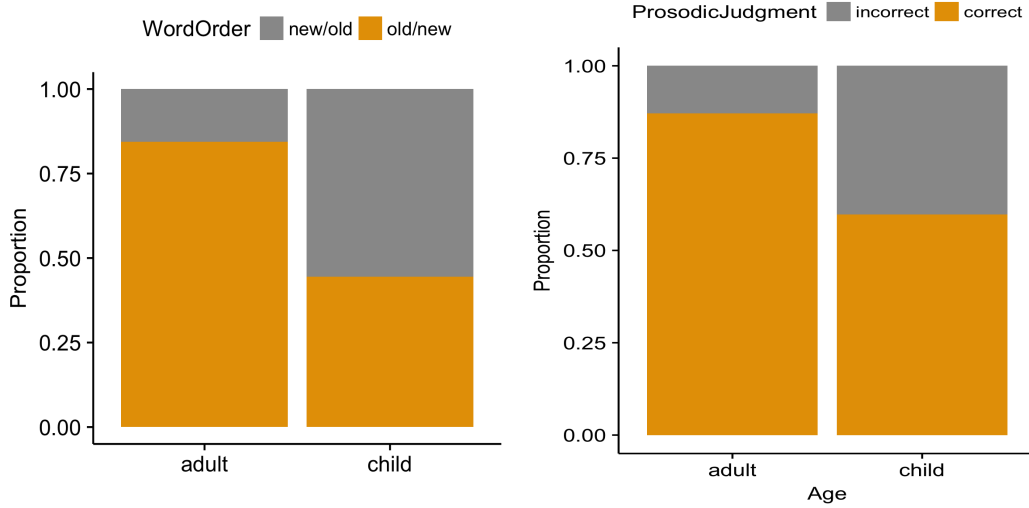


Figure 3: Proportion of new/old and old/new responses for adults and children (left panel), and proportion of utterances correctly judged (right panel).

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	1.999338912	0.268262321	7.452924817	< .00001***
Age: Child	-1.584464999	0.339116978	-4.672325781	< .00001***

Table 3: Summary of the generalized linear mixed-effects model for Prosodic Judgment

There was furthermore an interaction between age group and word order for prosodic judgment: When children produced the conjuncts in the ‘old-before-new’ order, they prosodically signaled the referents’ information status less clearly than adults did ($\beta = -2.8265$, $p < .0001$). In the following we look more closely at this last finding: Why was the prosodic judgment worse for children’s ‘old-before-new’ responses?

In order to find out what may have caused the phonetician to judge ‘old-before-new’ responses erroneously as ‘new-before-old’, we investigated these responses ($N=71$) in more detail. Prosodic judgments are judgments about *relative prominence* within a phrase. We therefore analyzed in which way the speakers’ realization of the new referent (second noun phrase) differed from their realization of the old referent (first noun phrase) in terms of F0 peak height difference, difference in F0 excursion, mean intensity, and duration. Figure 4 shows the differences for each of the four parameters for correct and incorrect prosodic judgments.

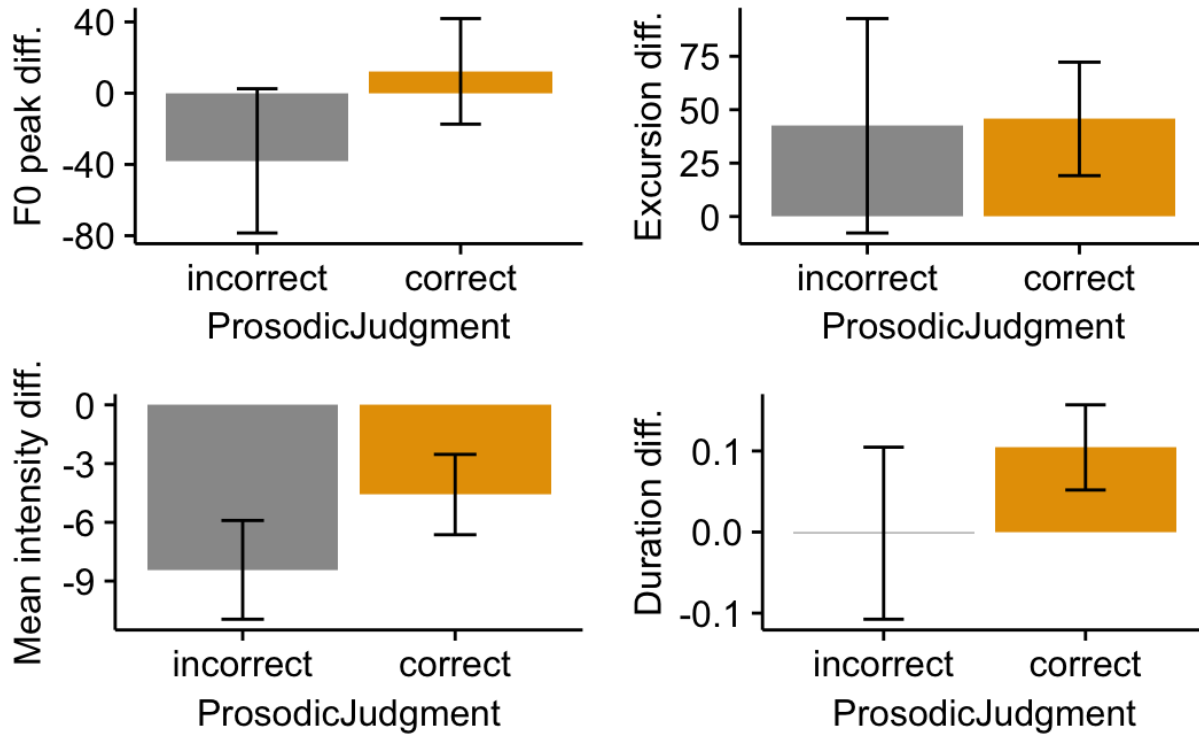


Figure 4: Differences in F0 peak height (top left), F0 excursion (top right), mean intensity (bottom left), and duration (bottom right) for correct and incorrect prosodic judgments.

We found that in cases in which the judgment was incorrect, the F0 peak difference between new and old referents was larger (-39dB on incorrect vs. 10dB on correct judgments). In other words, in the incorrectly judged pairs, the final (new) referent was produced with a relatively lower pitch peak. There was no discernible difference between correctly and incorrectly judged responses with respect to the excursion difference of the pitch curve on the words. Note that excursion was measured between the maximum and the minimum anywhere in the word. Thus, the excursion could have been either on the rising part of an accent or on the falling part. For intensity, we found that in incorrect judgments, the intensity difference between the two referents was larger, compared to those pairs that were judged correctly. This means that the final (new) referent was produced with lower intensity than the initial (old) referent. Finally, the duration of the stressed syllable of both old and new referents was the same in those pairs that were judged incorrectly, whereas in those that the phonetician perceived (correctly) as ‘old-before-new’, the stressed syllable second (new) referent was realized with considerably longer duration. We discuss how these characteristics may have caused the rater to make the wrong judgment in children’s ‘old-before-new’ responses in the next section.

4. Discussion. We investigated how the information status of referents influences English-speaking children’s and adults’ choice of word order and prosodic realization in noun phrase conjuncts. Specifically, we asked if children exhibit the same preference for the ‘old-before-new’ word order that has been demonstrated in adults. Our results suggest that this is not the case; however children did not show a preference for the ‘new-before-old’ order either, which has been found for German- and Spanish-acquiring children.

A possible explanation for the difference in ordering preference between the present study and the study with German-learning children reported in Narasimhan & Dimroth (2008) may be methodological. The experimental procedure in the German study involved toy replicas of real objects presented in a transparent container. Further, children were asked to help a second experimenter (who could not see the objects) to find matching pictures of the old and the new objects. Thus the children participated in a more interactive task in the original study compared to the present study in which children described 2D pictures of objects on the computer screen to the experimenter (or Teddy Bear). The methodological differences may account for the less frequent production of the ‘new-before-old’ word order in children acquiring English. However, a significant preference for the ‘new-before-old order’ was found in the study with the Spanish-English bilingual children (Ceja Del Toro, Chen, & Narasimhan 2016). Hence, methodological factors may not be the only reasons for the relatively reduced ‘new-before-old’ preference in English-speaking children. We suggest that the absence of a significant preference for the ‘new-before-old’ order in English-speaking children is related to the lack of word order flexibility in English. English has a more rigid word order compared to languages such as German (Callies 2009) and Spanish (Brown & Rivas 2011).

One may therefore expect that English-speaking children would use prosody to distinguish between old and new referents. This was our second research question: Do English-speaking children use prosody to distinguish between old and new referents in these noun conjuncts? However, we also did not find evidence for this; at least by auditory judgment alone, new and old referents could not be distinguished. This is in line with findings from two-year-old German-speaking children, who have been found to stress both words in two word phrases, irrespective of information status (Behrens & Gut 2005). But this finding is in contrast with findings from five-year-old German-speaking children, who do mark information status clearly, at least in narrative discourse (De Ruiter 2014).

Our third research question asked: How do word order and prosody interact? Here we compared adults’ and children’s success in signaling information status, given their chosen word order. Compared to adult speakers, the four-year-olds stood out in that they signaled the ‘old-before-new’ order less clearly. Recall that ‘old-before-new’ was the preferred word order for adults, but not for children in this study. When the children produced this word order, they tended not to accent new referents in phrase-final position sufficiently. Our follow-up acoustic analyses suggest that this was due to the fact that they produced these new referents with characteristics that are typically more associated with given referents. Lower pitch peaks (compared to the preceding old referent) gave rise to the impression that the referent is either down-stepped or deaccented. Similarly, children tended to produce the new referent with a more strongly reduced mean intensity. Finally, they failed to increase the syllable duration. Accentuation leads to increased syllable duration, and so does final lengthening. The fact that the syllable duration of the new referents (in the incorrectly judged utterances) was not longer than that of the old referents contributed to the auditory impression that these referents sounded old. We illustrate these observations in the schematic representation in Figure 5.

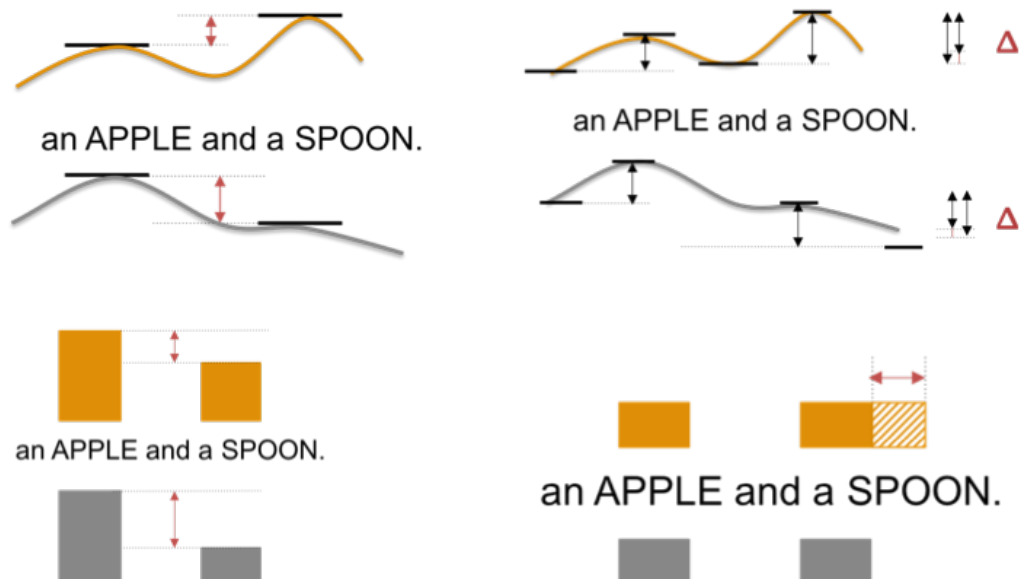


Figure 5: Schematic representations of the relative differences between old (e.g., *apple*) and new referents (e.g., *spoon*) in correctly (yellow lines) and incorrectly judged phrases for the four parameters (from top left to bottom right: F0 peak height difference, excursion difference, mean intensity difference, stressed syllable duration difference).

While this is only an exploratory analysis based on auditory impression, it suggests that, despite the role prosody plays in information status marking in English, children do not use the usual parameters to make new referents more prominent.

The cross-linguistic comparisons suggest that neither the ‘old-before-new’ nor the ‘new-before-old’ word orders are candidates for a universal early cognitive or communicative tendency influencing children’s production. Although children acquiring any language are likely to find novel referents more prominent than old referents, only children exposed to the flexible use of word order in the input are tempted to employ word order to express asymmetries in discourse-pragmatic prominence albeit in non-adult-like ways, as in the case of German- and Spanish-learning children. Children are also not adult-like in prosodically distinguishing old versus new referents in English. This suggests that habitual use of prosody to signal information status in the input does not suffice to facilitate adult-like marking of information status in children. Our study reveals that despite the early acquisition of intonation and word order in children, the use of these means to mark information status distinctions such as ‘old’ versus ‘new’ develops gradually.

References

- Arnold, Jennifer E., Kaiser, Elsi, Kahn, Jason M., & Kim, Lucy K. 2013. Information structure: linguistic, cognitive, and processing approaches. *Wiley Interdisciplinary Reviews: Cognitive Science* 4(4). 403–413. <https://doi.org/10.1002/wcs.1234>.
- Arnold, Jennifer E., Losongco, Anthony, Wasow, Thomas, & Ginstrom, Ryan. 2000. Linguistic Society of America Heaviness vs. Newness: The Effects of Structural Complexity and Discourse Status on Constituent Ordering. *Language* 76(1). 28–55. <https://doi.org/10.1353/lan.2000.0045>.

- Baumann, Stefan, & Grice, Martine. 2006. The intonation of accessibility. *Journal of Pragmatics* 38(10). 1636–1657. <https://doi.org/10.1016/j.pragma.2005.03.017>.
- Behrens, Heike, & Gut, Ulrike. 2005. The relationship between prosodic and syntactic organization in early multiword speech. *Journal of Child Language* 32(1). 1–34. <https://doi.org/10.1017/S0305000904006592>.
- Bock, J. Kathryn, & Irwin, David E. 1980. Syntactic effects of information availability in sentence production. *Journal of Verbal Learning and Verbal Behavior* 19(4). 467–484. [https://doi.org/10.1016/S0022-5371\(80\)90321-7](https://doi.org/10.1016/S0022-5371(80)90321-7).
- Boersma, Paul, & Weenink, David. 2016. Praat: doing phonetics by computer [Computer program]. Retrieved from <http://www.praat.org/>.
- Branigan, Holly P., McLean, Janet F., & Reeve, Hannah. 2003. Something old, something new: Addressee knowledge and the given-new contract. In Richard Alterman, David Kirsh (eds.), *Proceedings of the 25th Annual Meeting of the Cognitive Science Society*. 180–185. Mahwah, NJ: Lawrence Erlbaum Associates.
- Ceja Del Toro, Pablo, Chen, Jidong, & Narasimhan, Bhuvana. 2016. Information structure in bilingual Spanish-English child speech. Presented at the *2016 International Workshop on Language Processing and Production*, San Diego, CA.
- Chafe, Wallace L. 1974. Language and consciousness. *Language* 50(1). 111–133. <https://doi.org/10.2307/412014>.
- Clark, Herbert H., & Clark, Eve V. 1977. *Psychology and language: An introduction to psycholinguistics*. New York: Harcourt Brace Jovanovich.
- Clark, Herbert H., & Haviland, Susan E. 1977. Comprehension and the given-new contrast. In Roy O. Freedle (ed.), *Discourse Production and Comprehension. Discourse Processes: Advances in Research and Theory, 1*. 1–40. Norwood, NJ: Ablex.
- De Ruiter, Laura E. 2014. How German children use intonation to signal information status in narrative discourse. *Journal of Child Language* 41(5). 1015–61. <https://doi.org/10.1017/S0305000913000251>.
- Ferreira, Victor S., & Yoshita, Hiromi. 2003. Given-new ordering effects on the production of scrambled sentences in Japanese. *Journal of Psycholinguistic Research* 32(6). 669–692.
- Fowler, Carol A., & Housum, Jonathan. 1987. Talkers’ signaling of “new” and “old” words in speech and listeners’ perception and use of the distinction. *Journal of Memory and Language* 26(5). 489–504. [https://doi.org/10.1016/0749-596X\(87\)90136-7](https://doi.org/10.1016/0749-596X(87)90136-7).
- MacWhinney, Brian. 2000. *The CHILDES project: The database* (Vol. 2). Psychology Press.
- Narasimhan, Bhuvana, & Dimroth, Christine. 2008. Word order and information status in child language. *Cognition* 107(1). 317–329. <https://doi.org/10.1016/j.cognition.2007.07.010>.
- Narasimhan, Bhuvana, Duffield, Cecily J., & Kim, Albert. 2015. Accessibility and linear order in phrasal conjuncts. In Ida Toivonen, Piroska Csúri, & Emile van der Zee (eds.), *Structures in the Mind: Essays on Language, Music, and Cognition in Honor of Ray Jackendoff*. 211–234. Cambridge MA: MIT Press.
- Prince, Ellen F. 1981. Toward a taxonomy of given–new information. In P. Cole (ed.), *Radical pragmatics*. 223–256. New York: Academic Press.
- R Core Team. 2016. *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org>.